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(54) Title: FIBRE BONDING

(57) Abstract

There is disclosed a method for bonding a fibre assembly comprising impinging a high temperature jet on the assembly to melt a melt component of the assembly to fuse fibres together.

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FIBRE BONDING

This invention relates to producing fibre assemblies and fabrics.

In addition to the age-old methods of making fabric, namely weaving and knitting, numerous so-called "non-woven" fabricating methods have been developed which produce fabrics more quickly and/or at lower cost, or with special properties. Some of these methods use heat to melt fusible fibre in a web to produce a so-called thermobonded fabric - such fabrics are produced using a heated roller which may have an embossed pattern which spot- or point- bonds the web so as to leave intervening unbonded areas so that he resulting material has a degree of textile flexibility, though the fabrics tend to be quite stiff nevertheless. Thermobonding is usually associated with high energy consumption.

For bonding without heat, methods have been developed using rows of chain stitches of warp threads (stitch bonding) or rows of quasi-chain stitches of fibres pulled by compound needles from the web (fleece knitting), needle punching, and hydro-entanglement, in which high pressure jets, usually of water, impinge the web at closely spaced apart locations and cause local entanglement which bonds the web into a fabric. Such fabrics tend to have relatively poor textile qualities in at least some regards - they may have better flexibility, but correspondingly less strength and dimensional stability than woven or knitted fabrics, and are often characterised by a marked tendency to pill.

The present invention provides methods for making improved non-woven fabrics.

The invention comprises a method for bonding a fibre assembly comprising impinging a high temperature jet on the assembly to melt a melt component of the assembly to fuse fibres together.

The jet may entangle as well as melt fibres and particularly interesting results are obtained when jets melt and entangle. It may be arranged that all jets melt and entangle to greater or lesser relative extents to produce fabrics or structures of various characteristics. It may be arranged that purely entangling jets are present with purely melting jets or with jets that both melt and entangle.

The melt component may be a thermoplastic fibre - by "fibre" as used herein, unless otherwise indicated, is meant continuous filament or staple fibre. Two thermoplastic fibres may be used together, one of which, by virtue of its lower melting temperature, comprising a melt fibre, the other a structure fibre.

A thermoplastic fibre may be the sole constituent of the assembly and molten portions of it fuse other portions together.

A melt fibre may be a single component fibre or may be a bicomponent fibre having at least one thermoplastic component.

A thermoplastic fibre may however be one of at least two components of the assembly, the other of which may or may not be thermoplastic, and may melt to bond other or the other component fibre.

The jet may be a steam jet, and may be a super- heated steam jet.

The invention also comprises a method for making a fabric comprising bonding a fibre web using a method as described.

A plurality of spaced-apart jets may act on the web; the jets may be spaced apart in two-dimensional array. The jets may be apertures in a platen backed by a superheated steam

plenum chamber, or may be apertures in a rotary cylinder.

The jets may be spaced apart by distances of the order of two or three millimetres.

The fibre assembly may be backed by a permeable support, which may comprise a perforate belt or wire, which may wrap around a rotary cylinder for example or which may constitute a conveyor for the web.

The invention also comprises a bonded fibre assembly and a bonded fabric produced by a method as described.

The invention also comprises apparatus for bonding a fibre assembly comprising high temperature jet means adapted to impinge a fibre assembly in such manner as to melt a melt component of the assembly to fuse fibres together.

The high temperature jet means may comprise steam, in particular superheated steam jet means.

The apparatus may be adapted for making a fabric comprising fibre web support means adapted to support a fibre web for impingement by said high temperature jet means. Said support means may be permeable, and may comprise a perforate belt or wire.

Said steam jet means may comprise an apertured platen, which may be backed by a plenum chamber. Said support means may, on the other hand, comprise an apertured roller.

The steam jet means may comprise steam jets arranged in an array with a spacing of the order of 2 or 3 mm.

The invention also comprises a fibre assembly or fabric produced by any such apparatus. The invention also comprises a fabric comprising a web of textile fibre having spaced apart bonding points where the fibres are less densely arranged than in the rest of the web and have interfibre melt bonds.

Embodiments of fabrics and apparatus and methods for producing fabrics according to the invention will now be described with reference to the accompanying drawings, in which :-

Figure 1 is a diagrammatic section through steam jet means of the invention acting on a fibre web;

Figure 2 is a diagrammatic side elevation of fabric bonding plant including steam jet means according to the invention;

Figure 3 is a diagrammatic cross-section through another fibre bonding plant according to the invention;

Figure 4 is a view of a section of a surface of a bonded web according to the invention;

Figure 5 is a view like Figure 4 to a larger scale;

Figure 6 is a view of a single bond point of a web as depicted in Figures 4 and 5;

Figure 7 is a view of bonded fibres in a bond point as illustrated in Figure 6;

and Figure 8 is a view like Figure 7 of a different fabric according to the invention.

The drawings illustrate methods and apparatus for bonding a fibre assembly and in particular a fibre web 11 to form a bonded fabric, and bonded fabrics formed thereby.

Figures 1 to 3 illustrate apparatus and methods of using it in which high temperature superheated steam jets 12 impinge on the fibre web 11 to melt a melt component fibre thereof to fuse fibres together.

In each case discussed herein the melt component is a thermoplastic fibre. It must, however, be pointed out that it would be possible to incorporate a melt component in some other way, such, for example, as in powder or particulate form. However, using a melt component fibre means that any unmelted melt component remains as part of the fibre make-up of the fabric and this suggests that incorporation of melt component in fibre form is most efficient.

As mentioned above, hydroentanglement has been used as a means of making a fabric from a web or fleece of fibre, and the jets contemplated for use in the present invention can correspond substantially to those used in hydroentanglement in regard to size, spacing, cross-sectional area, velocity and so forth, with the essential difference that they are hot enough to melt at least a melt component of the fibre assembly or web to fuse fibres together.

Figures 1 and 2 illustrate an arrangement in which a plenum chamber 21 backs a platen 22 with jet apertures 23 impinging the web 11 supported on a perforate backing mesh or wire 24. In Figure 2, it can be seen that the mesh or wire 24 constitutes an endless belt running over rollers 25 and beneath the platen 22, the plenum chamber 21 of which is supplied with superheated steam from a steam generator 26.

A support bed 27 (which may also be perforated to allow escape of steam) is provided beneath the platen 22 to support the mesh or wire 24.

The platen 22 can be raised from and lowered on to the top of the web 11 which can be moved intermittently, a platen-length at a time, when the platen is raised, steam being applied when the travel is temporarily arrested and the platen lowered.

A continuous processing arrangement is illustrated in Figure 3 in which a perforated roller 32 with an interior plenum chamber 31 is used instead of the platen 21 of Figures 1 and 2. The web 11 is guided around and pressed against the platen 32 by a perforate belt 34 running on rollers 35. The jets of the roller 32 are blanked off except where the web 11 is wrapped.

In both embodiments, the treatment zone is encased in suitable jacket means, not shown, to prevent dangerous escape of high pressure, superheated steam and to provide for heat and possibly water recovery. Appropriate controls and safety measures will also be provided, as well as the necessary fibre preparation and web-laying equipment, fibre take-up and so forth.

Figure 4 shows a surface, somewhat enlarged, of a bonded web produced on apparatus as described with reference to Figures 1 to 3. "Spots" 41 are noticeable in a configuration corresponding to the array of jets in the apparatus. Figures 5 and 6 show the spots 41 to larger scales - some bonding is evident more particularlyin Figures 6. Figure 7 is a further enlargement of a fibre region within a spot 41 in which melt bonds are clearly visible as globules 42. This is typical of bonding with distinct melt and structure components.

Figures 8, however, which is a view to a somewhat higher magnification even than Figure 7, illustrates a bond typical of a single component fabric where the individual fibres 81 become tacky and form bonds by means of fibrils 82 bridging them. Of course, both types of bond may be found within a multicomponent fabric according to the processing temperatures.

In conventional hydroentanglement, instead of spot bonding, jets can be traversed relatively to the web to form continuous line bonds in various patterns. The equivalent would be possible also with methods according to the invention.

A variety of fabric specifications may also be generated by using different temperatures and pressures, patterned backing elements, patterns and sizes of jet orifices and different degrees of constricting the fibres in the web against movement under the jets. The fibre may be continuous filament or staple fibre or a mixture of the two, and a melt component may be provided as one component of a bicomponent fibre.

The superheated steam (or other high temperature fluid) may contain additives which may help or serve to effect thermal bonding between fibres or to condense a treatment substance on to the fibres, and indeed many variations on the basic principles hereinabove disclosed will be found useful.

Typical fabrics produced by the method of the invention have tenacities (in Cn/tex) of about 1.3 which compares favourably with thermally bonded fabrics (about 1.2) and very favourably with conventionally hydro- entangled fabrics (about 0.8). The flexural rigidity of a typical fabric of the invention is about 1200 mg.cm, which is intermediate between a thermally bonded fabric (about 1700 mg.cm) and a hydroentangled fabric (about 800 mg.cm). However, as noted, the fabric of the invention can be produced to different specifications, and particularly at different strengths and flexural rigidities without the one necessarily having to be traded off against the other.

CLAIMS

1. A method for bonding a fibre assembly comprising impinging a high temperature jet on the assembly to melt a melt component of the assembly to fuse fibres together.

2. A method according to claim 1, in which the melt component is a thermoplastic fibre.

3. A method according to claim 2, in which the thermoplastic fibre is the sole constituent of the assembly and molten portions of it fuse other portions together.

4. A method according to claim 2, in which the thermoplastic fibre is one of at least two components and melts to bond other fibre components.

5. A method according to any one of claims 1 to 4, in which the jet is a steam jet.

6. A method according to claim 5, in which the steam jet is a superheated steam jet.

7. A method for making a fabric comprising bonding a fibre web using a method according to any one of claims 1 to 6.

8. A method according to claim 7, in which a plurality of spaced-apart jets acts on the web.

9. A method according to claim 8, in which the jets are spaced spart in two-dimensional array.

10. A method according to claim 9, in which the jets are apertures in a platen backed by a superheated steam plenum chamber.

11. A method according to claim 9, in which the jets are apertures in a rotary cylinder.

12. A method according to any one of claims 7 to 11, in which the jets are spaced apart by distances of the order of two or three millimetres.

13. A method according to any one of claims 1 to 12, in which the jets entangle as well as melt fibre.

14. A method according to any one of claims 1 to 13, in which the fibre assembly is backed by a permeable support.

15. A method according to claim 14, in which the permeable support comprises a perforate belt or wire.

16. A method according to claim 15, in which the belt or wire wraps around a rotary cylinder.

17. A bonded fibre assembly produced by a method according to any one of claims 1 to 16.

18. A bonded fabric produced by a method according to any one of claims 1 to 16.

19. Apparatus for bonding a fibre assembly comprising high temperature jet means adapted to impinge a fibre assembly in such manner as to melt a melt component of the assembly to fuse fibres together.

20. Apparatus according to claim 19, in which the high temperature jet means comprise steam jet means.

21. Apparatus according to claim 20, in which the high temperature jet means comprise superheated steam jet means.

22. Apparatus according to any one of claims 19 to 21, adapted for making a fabric comprising fibre web support means adapted to support a fibre web for impingement by said high temperature jet means.

23. Apparatus according to claim 22, in which said support means are permeable.

24. Apparatus according to claim 23, in which said support comprises a perforate belt or wire.

25. Apparatus according to any one of claims 19 to 24, in which the steam jet means comprise an apertured platen.

26. Apparatus according to claim 25, in which the apertured platen is backed by a plenum chamber.

27. Apparatus according to claim 25, in which the steam jet means comprise an apertured roller.

28. Apparatus according to any one of claims 19 to 27, in which the steam jet means comprise steam jets arranged in an array with a spacing of the order of 2 or 3 mm.

29. A fibre assembly or fabric produced by apparatus according to any one of claims 19 to 28.

30. A fabric comprising a web of textile fibres having spaced apart bonding points where the fibres are less densely arranged than in the rest of the web and have interfibre melt bonds.

1/2

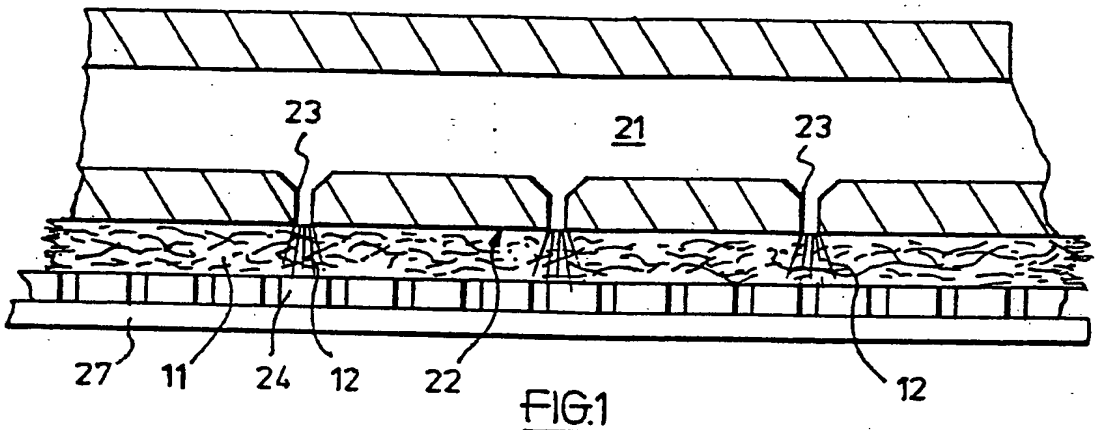

FIG.1

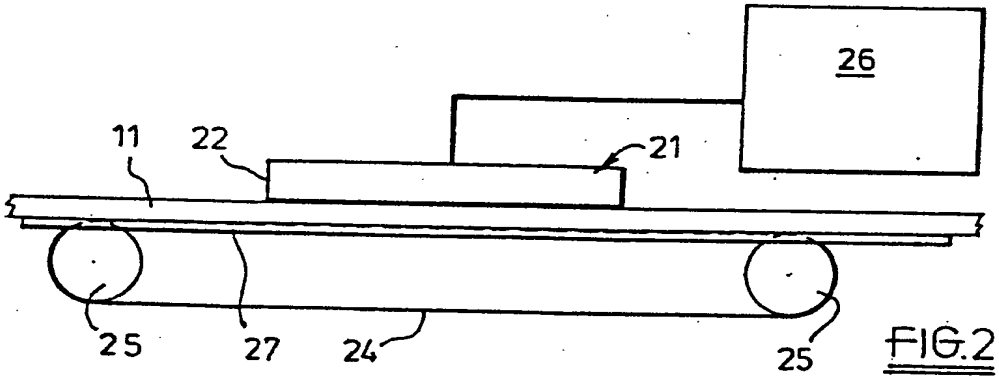

FIG.2

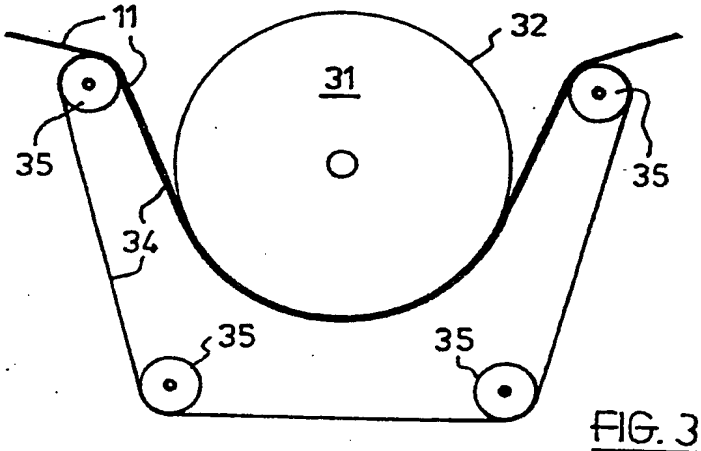

FIG. 3

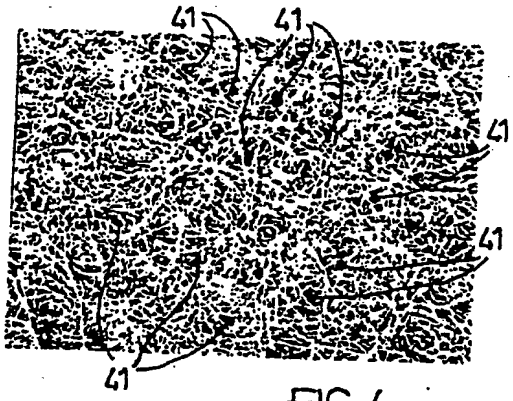

FIG.4

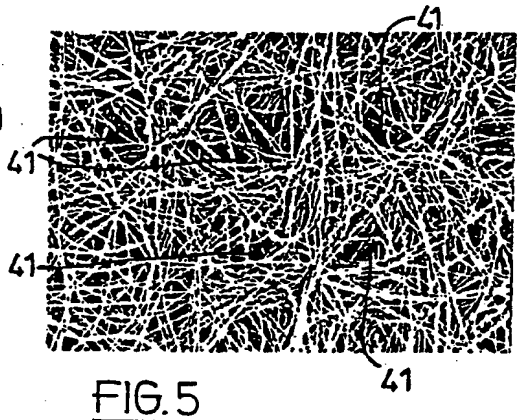

FIG.5

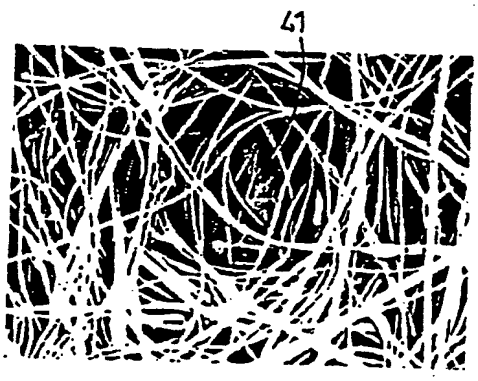

FIG.6

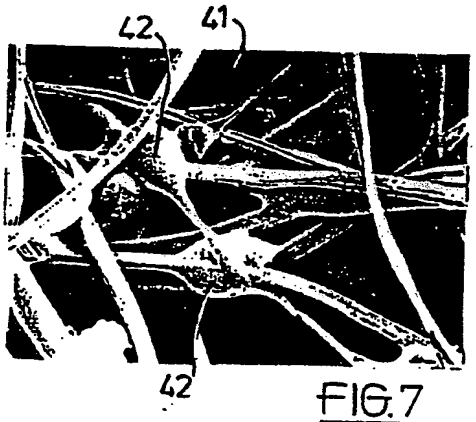

FIG.7

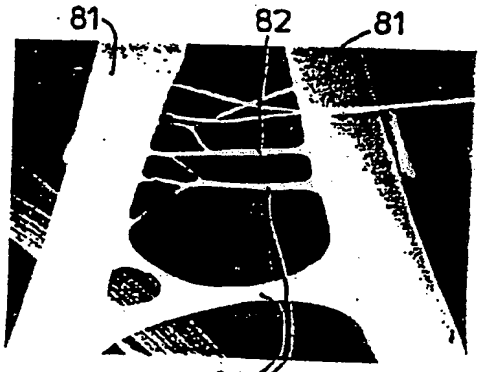

FIG.8

INTERNATIONAL SEARCH REPORT

Inter[illegible]al Application No
PCT/GB 94/01856

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D04H1/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US,A,3 322 584 (WELLIN BERGER) 30 May 1967 see the whole document	1-6,19 7-18, 20-30
X A	US,A,3 192 560 (HUFFMAN) 6 July 1965 see the whole document	1,19 2-18, 20-30
A	US,A,3 353 225 (WILLIAM C.DODSON) 21 November 1967 see the whole document	1-29
A	US,A,3 458 905 (WILLIAM C. DODSON) 5 August 1969 see claims; examples	1-29

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTE[redacted]TIONAL SEARCH REPORT

...information on patent family members

Inter...al Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3322584		FR-A- 1462423 GB-A- 1045590	
US-A-3192560		NONE	
US-A-3353225		NONE	
US-A-3458905	05-08-69	NONE	

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